

SPECIES OF THE GENUS *LILOPHURA* PILSBRY, 1893 (MOLLUSCA, POLYPLACOPHORA)

By EUGENE LELOUP. D.Sc.*

The genus *Liolophura* includes particularly three species, *L. japonica* (Lischke, 1873), *L. gaimardi* (Blainville, 1825) and *L. hirtosa* (Blainville, 1825) representatives of which display many analogies between each other: the oval, elongate form; the shell little elevated; the sculpture differentiated on the median and lateral areas, less pronounced on the lateral areas and composed of granules, more or less thick, abundant and regularly arranged; the growth striae well marked; the coloration rather dull, varied by more or less extensive lighter regions, with a narrow brown band always present on the jugum of valves II-VII, valve I being divided into three sections, of which the middle, more or less wide, is light coloured. The perinotum is covered on the upper surface with two kinds of spines; the most abundant kind are of varied shape, generally thick, coloured and sculptured with fine, longitudinal granulose ribs; the others are small, slender, elongate, cylindrical, with very fine longitudinal ribs, and plentifully covered with brown pigment; at its marginal edge, the perinotum bears solid, elongate spines, and on its lower surface, rectangular scales which are thick and curved.

In order to avoid the description of the species which have, moreover, been given perfectly by other authors, it seemed to be more useful to prepare a comparative table in which the distinguishing characters of the species are given, and to follow this with the references and figures, a record of the material observed, the geographical distribution of the species under consideration, and finally some remarks suggested by the study of the specimens.

Liolophura japonica (Lischke, 1873)

(Text figs. 1, 2 and 5a, Pl. 3, fig. 1.)

Liolophura japonica (Lischke, 1873). Taki, Isao, 1938, Sci. Rep. Tohoku Imp. Univ. (4), Biol., 12, No. 3, pp. 398-404, pl. 15, fig. 3, pl. 32, figs. 15, 16, pl. 33, figs. 1-8, pl. 34, figs. 1-4 (bibliography and synonymy).

MATERIAL OBSERVED:

Collection of the Institut royal des Sciences naturelles, Belgium:

Japan (2 specimens, largest 18 x 20.5 mm., curled up). Hirado-Hizen (3 specimens, largest 50 x 26 mm., girdle compressed). Fukura, Awaji (2 specimens, largest 38 x 23 mm., a little curled and girdle compressed). Enoshima (1 specimen, 21 x 14 mm., curled up). Locality? (1 specimen, 26 x 20 mm., curled up).

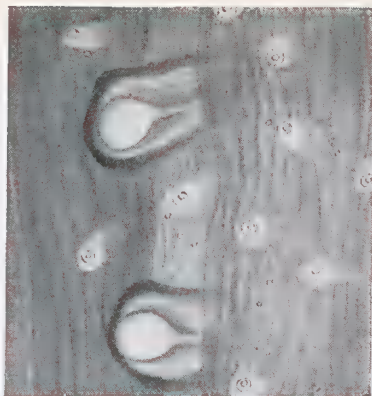
(Under the name var. *tessellata*): Japan (5 specimens, largest 27.5 x 14 mm., girdle compressed, 22 x 22 mm., curled up and compressed). Yokohama (1 specimen, 34 x 17 mm., girdle compressed).

(Under the name form *tenuispinosa*): See E. Leloup, 1939, Bull. mus. roy. Hist. nat. Belg., 15, 1.

*Institut royal des Sciences naturelles, Brussels, Belgium.

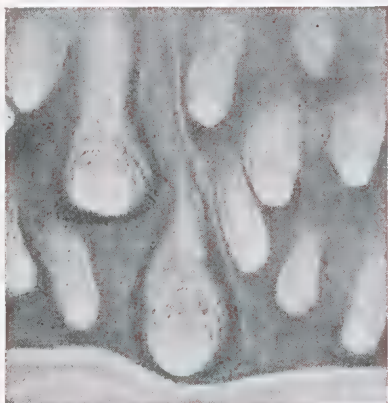


A.

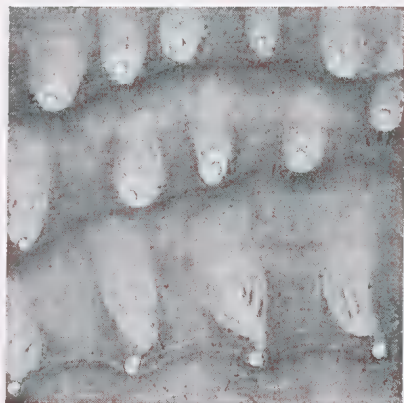


B.

FIGURE 1.

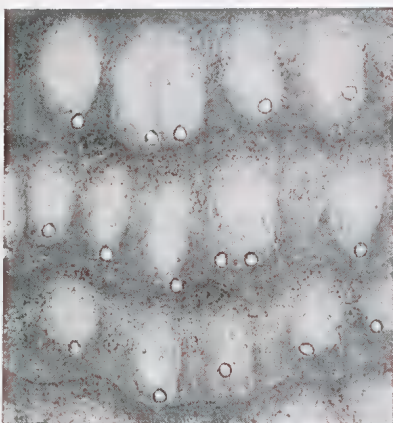


A.

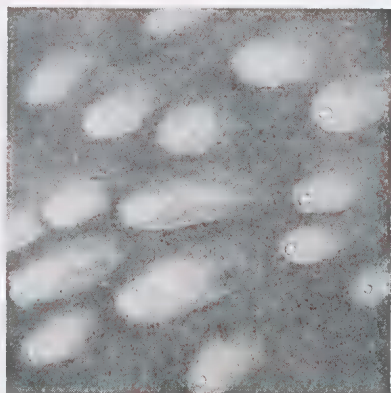


B.

FIGURE 2.



A.



B.

FIGURE 3.

PLATE 3.—AESTHETES (Mag. x 120).

Figure 1: *Liolophura japonica* (Lischke, 1873), form *tenuispinosa*.
A—Median area. B—Lateral area.

Figure 2: *Liolophura gaimardi* (Blairville, 1825).
A—Median area, pleural region. B—jugal region.

Figure 3: *Liolophura gaimardi* (Blainville, 1825), form *platispinosa*.
A—Median area, jugal region. B—Lateral area.

Collection of the British Museum (Natural History), London:

Misaki, sea-level, May, 1921, V. Insole Esq., No. 43, 1921-12-20, 254, 257 (1 specimen, 22.5 x 16 mm.) No. 52, 1921-12-20, 298, 307 (3 specimens, largest 19 x 13.5 mm.). Enoshima, Dr. Anderson, No. 80-12-10, 284-5 (2 specimens, largest 30 x 17 mm., girdle compressed).

Collection of the Zoologisches Museum, Hamburg:

Fokien, China, 9-IX-1912, Konsul G. Sumssen (20 specimens, largest 34 x 20 mm., girdle compressed, (form *tessellata*). North Formosa, coll. Warburg (2 specimens, largest 27 x 20 mm.).

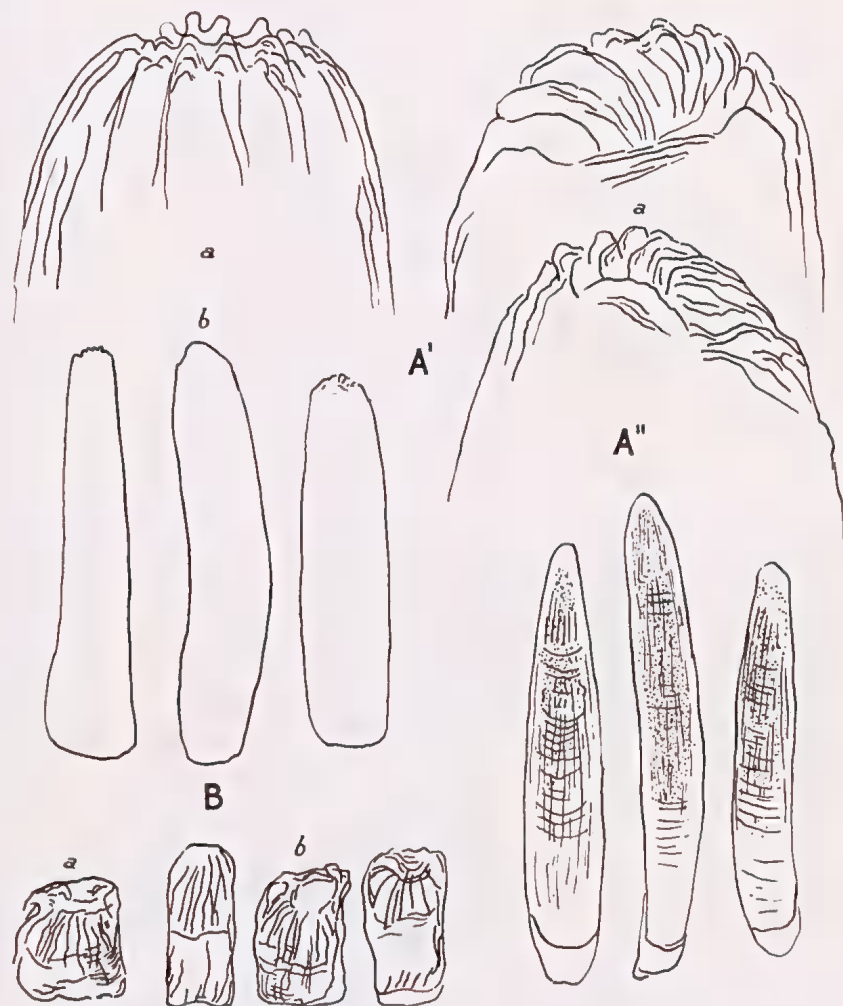


Figure 1: *Liolophura japonica* (Lischke, 1873). Specimen from Hirado-Hizen. Girdle Elements: A—Upper surface: A1—Thick spines. a—Extremities (x 350), b—(x 55). A11—Small spines (x 350). B—Lower surface: (x 350). a—in the centre, b—near the margin.

GEOGRAPHIC DISTRIBUTION:

See Isao Taki (1938): Japan and vicinity.

Liolophura gaimardi (Blainville, 1825)

(Text figs. 3, 5b, Pl. 3, fig. 2.)

Liolophura gaimardi. Iredale, T., & Hull, A. F. B., 1926, Aust. Zool. 4, p. 262, pl. 37, figs. 13-16, 19, 31 (bibliography and synonymy). Pilsbry, 1894, Proc. Acad. Nat. Sci. Philadelphia, p. 87. Casto de Elera, Fr., 1896, Cat. Sist. Fauna Philipinas, 3, p. 442. Tate, R., and May, W. L.,

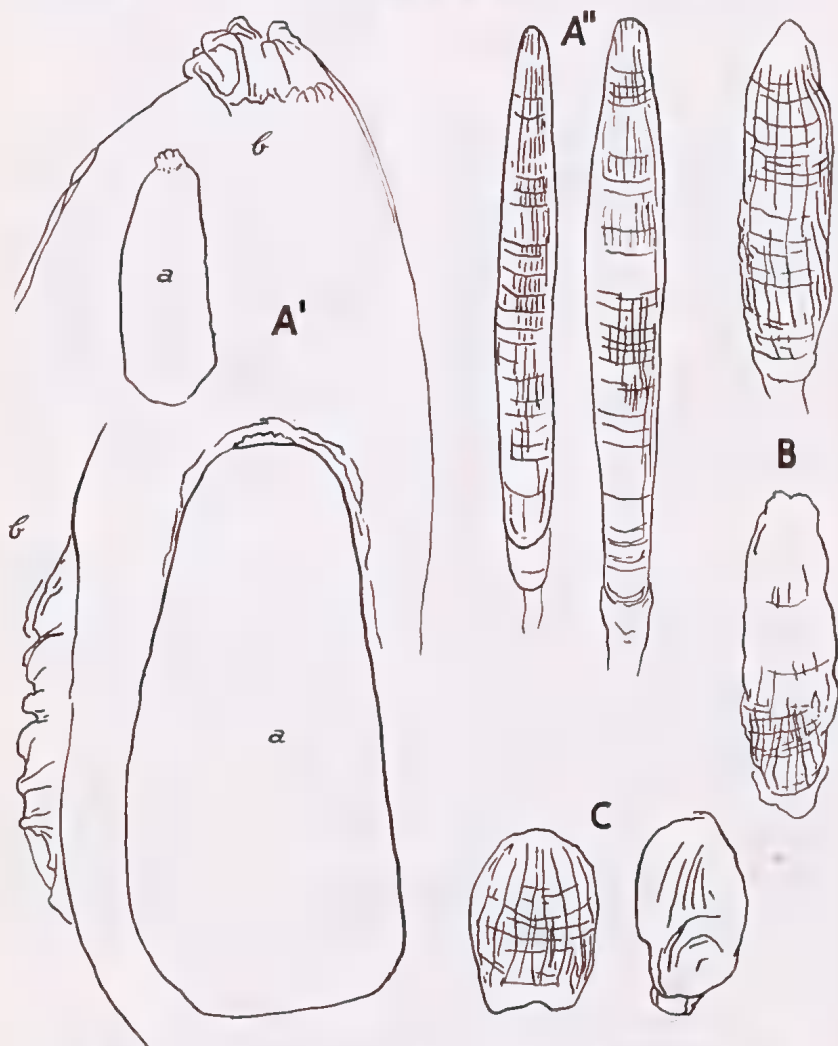


Figure 2: *Liolophura japonica* (Lischke, 1873), var. *tessellata* Pilsbry, 1893. Specimen from North Formosa. Girdle Elements: (Mag. x 350, a- x 55.) A-Upper surface: A1-Two thick spines, b-their respective extremities. A11-Small spines. B-Marginal edge, scaly-spines. C-Lower surface, scales.

1901, Proc. Linn. Soc. N.S.W., 26, p. 415. Hidalgo, J. G., 1904-1905, Catal. Mol. testaceos Filipinas, Jolo y Marianas, 1, p. 272. Nierstrasz, H., 1905, Chitonen Siboga-Exp., 48, pp. 108, 110; 1905, Notes from the Leyden Mus., 25, pp. 154-155, pl. 10, figs. 20, 21. May, W. L., & Torr, W. G., 1912, Pap. Proc. Roy. Soc. Tasmania, p. 40. Ashby, E., 1922, Trans. Proc. Roy. Soc. S. Aust., 46, p. 581; 1926, Rept. Austral. Ass. Adv. Sci., 17,

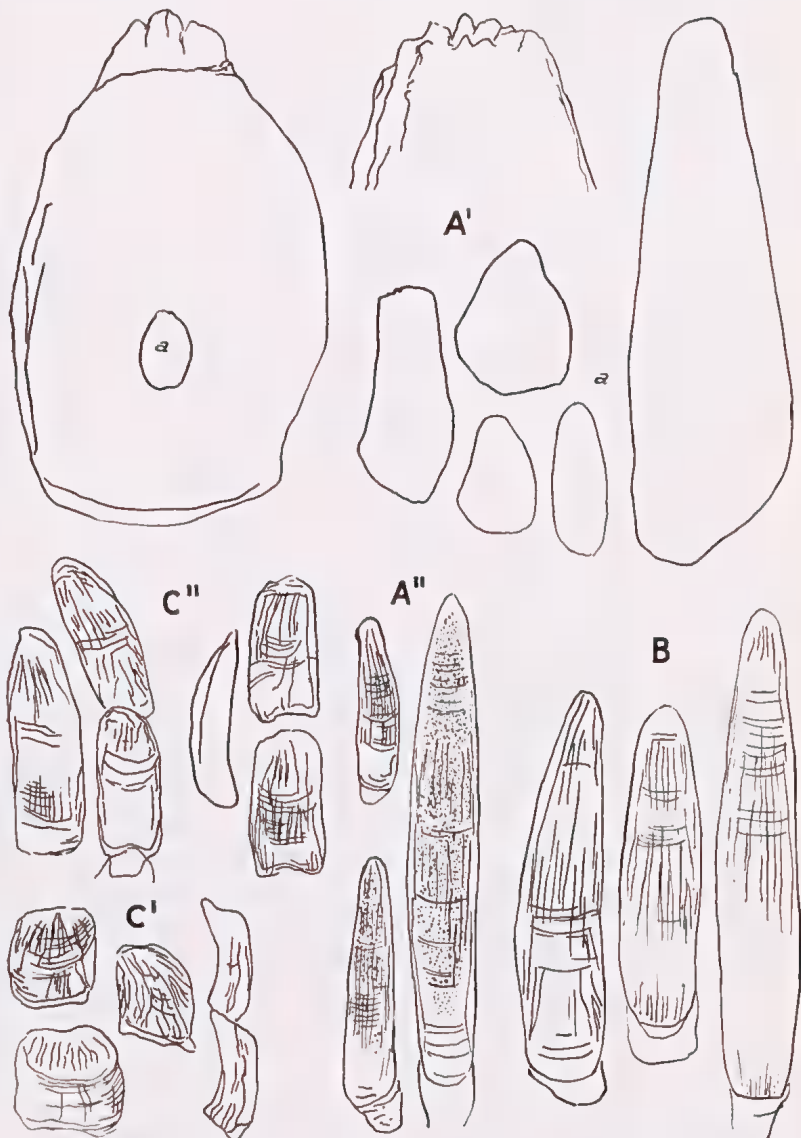


Figure 3: *Liolophura gaimardi* (Blainville, 1825). Girdle Elements. (Mag. x 350). A—Upper surface: A1—Scales (a — x 55). A11—Small pigmented spines. B—Marginal edge, scaly-spines. C—Lower surface, scales: C1—in the centre, C11—near the marginal edge.

pp. 380, 384, 386, 388-9. Bergenhayn, J. R. M., 1930, Kungl. Sv. Vetens. Handlingar, 9, p. 32, pl. 8, figs. 76, 77; 1937, Arch. F. Mollusk, 69, pp. 44-48, figs. 1, 2. Allan, J., 1950, Australian Shells, p. 238, fig. 55 (6a).

Acanthopleura quatrefagei Rochebrune. Pisbry, H., 1892, Man. of Conch., 15, p. 96. Sykes, E. R., 1894, Proc. Mal. Soc. Lond., 1, p. 135. Thiele, J., 1909, Zoologica, 22, p. 8.

Acanthopleura brevispinosa (Sowerby), pars, Ashby, E., 1931, Ann. South African Mus., 30, p. 53.

Liolophura queenslandica Pilsbry. Iredale, T., & Hull, A. F. B., 1926, Aust. Zool., 4, p. 263, pl. 37, figs. 23-25, 30, 32 (bibliography). Hull, A. F. B., 1924, Proc. Roy. Soc. Queensland, 36, p. 109.

MATERIAL OBSERVED:

Collection of the Institut royal des Sciences naturelles of Belgium:

Australia (10 specimens, largest 35 x 23 mm.). South Australia (2 specimens, 33 x 19 mm., girdle compressed, 32 x 18.5 mm. extended). Sydney (1 specimen, 28 x 15.5 mm.). Woolloomooloo (5 specimens, largest 34 x 20 mm., a little curled). Port Jackson (2 specimens, 35 x 20 mm., extended). Mosman Bay (1 specimen, 20 x 17 mm.). Rawak, Papouasie (2 specimens, largest 20 x 14.5 mm., a little curled). British New Guinea (1 specimen, 22 x 14 mm.). Co-type of *A. quatrefagei* (1 specimen, 13.5 x 7.5 mm.). Locality? (2 specimens, largest 32 x 20 mm., extended).

(Under the name form *platispinosa*): See E. Leloup, 1939, Bull. Mus. Hist. Nat. Belg., 15, 1.

Collection of the British Museum (Natural History), London:

Port Jackson, Dr. J. C. Cox, No. 93, 10, 28-36, 7 (2 specimens, 23.5 x 16.5 mm., extended, 25 x 15.5 mm.), No. 93-10-38, 38 (1 specimen, 35 x 27.5 mm.).

GEOGRAPHIC DISTRIBUTION

In the Pacific Ocean from Australia to the Malay Archipelago; Atlantic coast of Africa.

Liolophura hirtosa (Blainville, 1825)

(Text figs. 4, 5c.)

Liolophura hirtosa (*hirtosus*). Ashby, E., 1923, Trans. Proc. Roy. Soc. S. Aust., 47, p. 230; 1926, Rept. Austral. Ass. Adv. Sci., 17, pp. 379-380, 384, 387; 1928, Trans. Proc. Roy. Soc. S. Aust., 52, p. 180; 1929, J. Roy. Soc. W. Aust., 15, p. 52. *Clavarizona hirtosa*. Hull, A. F. B., 1923, Aust. Zool., 3, pp. 199-201 (bibliography and synonymy). Iredale, T., and Hull, A. F. B., 1926, Aust. Zool. 4, pp. 261-262, pl. 37, figs. 9-12, 17, 21. Allan, J., 1950, Australian Shells, p. 239, fig. 56 (10b).

MATERIAL OBSERVED:

Collection of the Institut royal des Sciences naturelles of Belgium:

Western Australia (1 specimen, 32 x 21 mm.). King George's Sound (1 specimen, co-type of *georgianus* Quoy & Gaimard, large valves separated; 2 specimens, 46 x 28.5 mm., and 32 x 26mm., curled up). King Island (1 specimen, co-type of *georgiana* Quoy & Gaimard, 39.5 x 30 mm.).

Fremantle (1 specimen, 52 x 30 mm.). Locality? (2 specimens, largest 40 x 29 mm.).

GEOGRAPHIC DISTRIBUTION:

Southern and Western Australia.

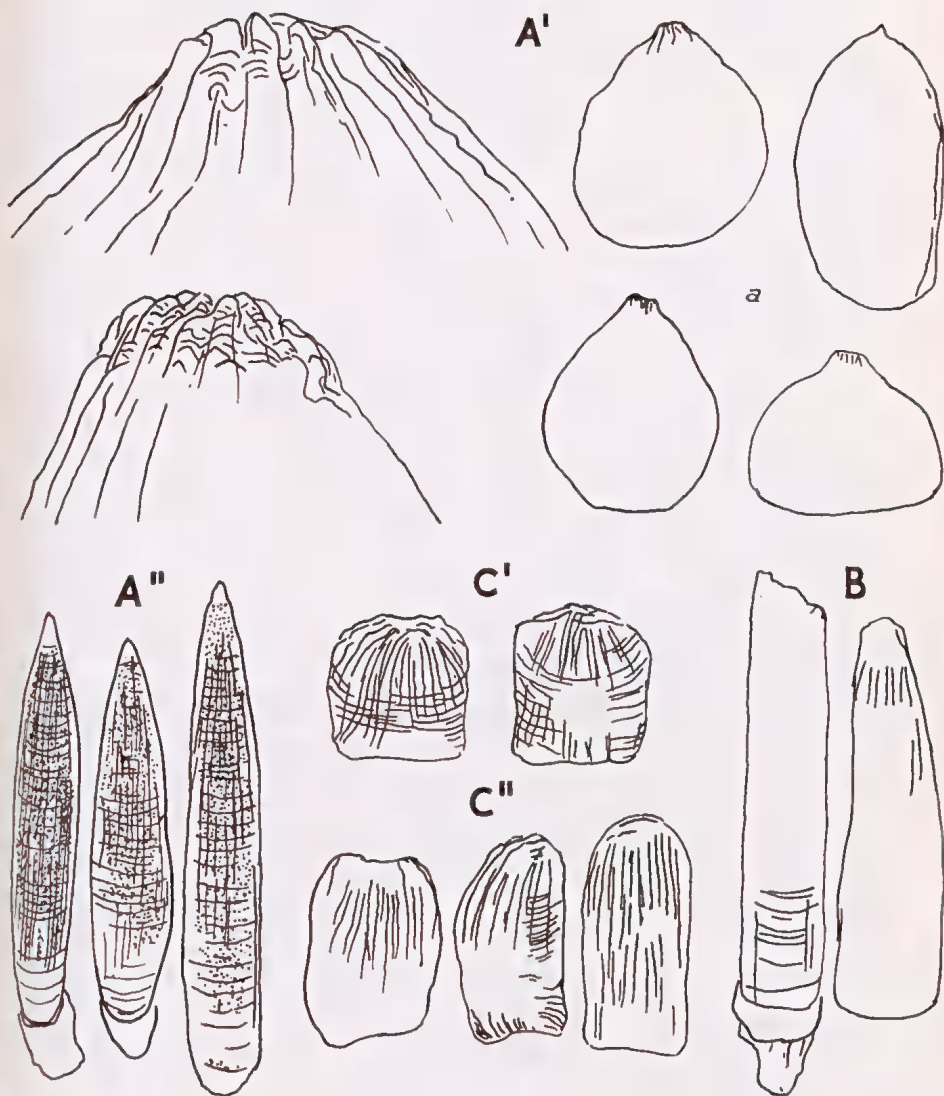


Figure 4: *Liolophura hirtosa* (Blainville, 1825). Circle Elements: (Mag. x 350, a x 55. A—Upper surface: A1—Scales. A11—Small pigmented spines. B—Marginal edge, scales. C—Lower surface: C1—in the centre, C11—near the marginal edge.

REMARKS.

1. H. Pilsbry (1892) created the var. *tessellata* for the specimens of *L. japonica* which have the upper face of the girdle covered with enlarged spines (text fig. 2); regarding this it must be stated that, in the species *japonica*, spines of this type are subject to notable variation. I had the opportunity of examining two specimens from northern Formosa, the girdles of which carried enormously thick spines. This fact is probably due to an environment rich in limestone, for the valves are likewise strongly encrusted; other specimens from Fokien (China) have similarly thickened and deformed spines, especially those from the lighter coloured zones of the girdle. According to H. Pilsbry, these chitons belong to the variety *tessellata*; however between these specimens with very thick spines, and those with not very thick spines are ranged specimens with spines of intermediate thickness. Thus, there is no well established delimiting point between the two extremes and the variety cannot always be determined very precisely.

In his recent work on the chitons of Mutsu Bay, Isao Taki (1938) makes the same statement and acknowledges the impossibility of separating the varieties of the species.

2. Among the *Liolophura* of different provenances, I have found (E. Leloup, 1939) specimens in which the perinotum bears very abundant spines of uniform length, short, slender, cylindrical, with rounded and white ends; light or dark, they are grouped in alternate regions. This girdle recalls that which is characteristic of *Acanthochiton spiniger*, form *haddoni* Winkworth. The characters of the shell are those of *L. japonica*. This form can be separated under the name *tenuispinosa*, only because of its girdle, its localised habitat in the Indo-Chinese region, and principally because of the lack of specimens with intermediate characters (see E. Leloup, 1939).

3. Among the specimens of *L. japonica* which have been examined, one well-developed specimen was found. The shell, which is in good condition, is of a rather uniform brown colour on the outside of the light coloured bands which extend laterally to the brown jugal band. The valves show, in addition to the structure on the lateral areas of not very numerous and not very regular granules, rather deep grooves delineating longitudinal ribs. On the median areas these ribs are developed mainly on the posterior half of these areas, where they are curved; on the anterior half they have been levelled by erosion and only the lowest parts of the grooves are evident.

4. *L. gaimardi* is known from eastern Australia, and, according to H. Nierstrasz (1905) from Australia to the Indo-Malayan archipelago. Among the Amphineura of the Zoological Museum, Hamburg, there are two specimens from Shikok (Japan); also the Institute royal des Sciences naturelles, Belgium, possesses a specimen from Tonkin. Although they belong to the species *gaimardi*, the characteristics of which they all show, these three specimens are distinguished by the investment of the girdle's upper side, which consists of spines of unequal length, but all considerably enlarged and recumbent. This peculiarity, and the new habitat of the species caused me to regard these specimens as belonging to a new form, *platispinosa* (see E. Leloup, 1939).

5. E. Ashby (1926) very wisely pointed out that the creation of a new genus for the species *L. hirtosa* by A. F. B. Hull (*Clavarizona* Hull,

1923) is hardly justified by the fact that the spines are enlarged in the form of scales on the upper face of the girdle. These elements really do not differ from those of other *Liolophura* except in dimensions, and among the short, enlarged spines of *L. gaimardi platyspinosa*, similar elements can be found. Under strong magnification, they are revealed not as scales covered by ribs on the upper side, but as spines completely sculptured with longitudinal ribs; moreover their arrangement on the girdle is not regular like that of the scales of the Chitoninae and the Ischnochitoninae; their implantation is that of the spines in the sheaths in swellings.

6. In 1894, H. Pilsbry has recognised among specimens of *L. gaimardi*, some of larger size than was previously known for the species, with a uniformly black girdle exhibiting shorter spines than those of the typical *gaimardi* girdle, and he has created for them the variety *queenslandica*. In 1923, A. F. B. Hull redescribed the variety with details of the sculpture which he contrasted with that of typical *gaimardi*. Having admitted that the characters of the sculpture have often deteriorated through erosion and are difficult to recognise, especially in fully grown individuals, he agreed to examine these characters only on juveniles in good condition. The specimens differed only as to the length of the spines; the other characters of the spines and their arrangement remained the same. This single (and not very important) difference does not justify the creation of the variety, a creation which otherwise is not much mentioned in literature.

7. Various authors have expressed their doubts as to the validity of the species *Acanthopleura quatrefagei* Rochebrune, 1881, and regarding its habitat, H. Pilsbry (1893) has placed it among the insufficiently described chitons. R. Sykes (1894) hesitated to include it in his list of Polyplacophora from South Africa. J. Thiele (1909) in his synonymy of certain species of Rochebrune, recognised it as *A. (Liolophura) gaimardi* and he corrected the name *A. quatrefagei* to the latter. However, comparatively recently E. Ashby (1931) placed *A. quatrefagei* in the synonymy of *A. brevispinosa*. The examination of one co-type of *A. quatrefagei* permits me to confirm the opinion of Thiele and has led me to place this species of Rochebrune in the synonymy of *L. gaimardi*, in particular that of its form *platyspinosa*, of which it has the characteristic shape, sculpture, coloration and perinotum.

8. Among the *L. gaimardi* preserved at the Institut royal des Sciences naturelles, Belgium, there is a specimen from "British New Guinea" (fig. 5, B3). Its shape not well developed (22 x 14 mm.), its girdle is covered on the upper side with spines, more tenuous than those of the Australian *L. gaimardi*, and it corresponds to the form *queenslandica*. When disarticulated, valve VIII is seen to have a callus, very superficially but regularly and completely pectinated (fig. 5, B3) with moreover, one deep fissure laterally on the left and two fissures on the right. Because of this conformation, the specimen comes singularly close to the genus *Acanthopleura*. However its not very strong pectination and the irregular fissures constitute rather indefinite characters; moreover the form of the callus and the peculiarities of the perinotum places this chiton with *L. gaimardi*, of which it possesses the form, coloration and sculpture.

9. In one specimen of the species *hirtosa* preserved at the Institut royal des Sciences naturelles, Belgium, but of unknown origin (fig. 5, C1) the valves are eroded to the point of being disarticulated in the median

area; the intervals thus produced are filled up with an unusual growth of the investment of the intervalve prolongations of the perinotum, on which spines are inserted close together, similar to those of the upper side of the girdle but smaller. This fact has been discovered and recorded by P. Dupuis in the Bulletin No. 7 of the Museum d'Histoire naturelle, of Paris, 1917. As indicated briefly in the comparative table, (p. 38), the callus of valve VIII is subject to variation (fig. 5). Smooth, large and flat on a typical *L. gaimardi* (fig. 5, B1), it has pectinations on the lateral regions in typical *L. japonica* (fig. 5, A1), weak and recumbent lamellations on *L. hirtosa* (fig. 5, C1), two lateral fissures next to the pectinated regions on *L. japonica tenuispinosa* (fig. 5, A2) and finally several fissures and pectinated teeth on *L. gaimardi platispinosa* (fig. 5, B2). These observations have been made on a relatively limited number of specimens; it would be interesting if they could be extended to a larger number of specimens. They seem to prove the very close relationship between *Liolophura* and *Acanthopleura*. The degree of relationship is most pronounced among the specimens from areas remote from the range of the

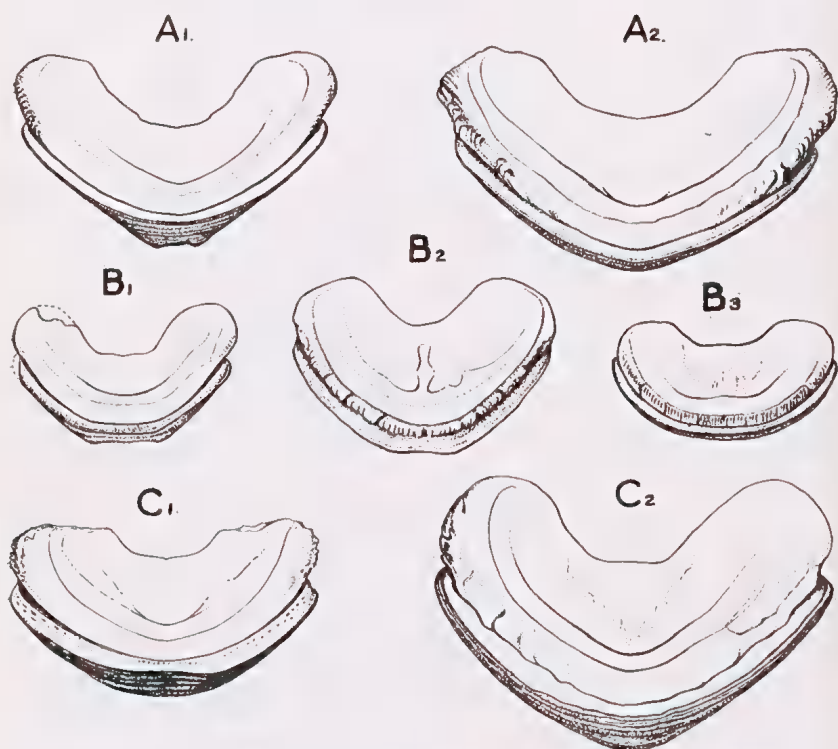


Figure 5: Valve VIII of *Liolophura* spp. Lower surface.

A—*L. japonica* (Lischke, 1837).

A1—Typical, locality unknown. A2—form *tenuispinosa*, Poulou Dama.

B—*L. gaimardi* (Blainville, 1825).

B1—Typical, Australia. B2—form *platispinosa*, Tonkin. B3—form *queenslandica*, British New Guinea.

C—*L. hirtosa* (Blainville, 1825).

C1—Origin unknown. C2—Australia.

typical species: in *L. japonica tenuispinosa* from Indo-China, *L. gaimardi platispinosa* from Japan and Tonkin, *L. gaimardi queenslandica* from "British New Guinea" (= Papua). *L. gaimardi platispinosa* has the posterior valve of an *Acanthopleura*, the fissures of which are more slanting and the teeth shorter; moreover the position of the insertion plate is more turned in and is much exceeded by the tegmentum (fig. 5, B2).

10. *Aesthetes*. *L. japonica* form *tenuispinosa* (Pl. 3, fig. 1). The disposition of the narrow elongated aesthetes (being a terminal macroaesthete accompanied by 5 to 8 microaesthetes rather much elongated) is not very regular. It is influenced by the growth of the tegmentum, for it is rather concentric. Very often the aesthetes are divided into two and these elements emerge at two different levels. On the lateral areas the disposition is even less regular than on the median areas. The extrapigmentary eyes intermingle in great numbers with the aesthetes; it is not uncommon to see two or three adjoining; they are also placed in concentric series.

L. gaimardi (Pl. 3, fig. 2). My observations regarding the structure of the tegmentum were made difficult by the erosion of the valves; however, one specimen of medium size and less damaged, did show aesthetes similar to those of *L. japonica*. Although the presence or the number of microaesthetes was not revealed, the disposition of the aesthetes is rather regular on the jugal regions where they are in level, transverse rows; in the pleural and lateral regions, their disposition is more diffuse and numerous extrapigmentary eyes emerge between the aesthetes. The zones of growth are strongly separated by furrows in which no aesthetes are apparent.

L. gaimardi platispinosa (Pl. 3, fig. 3). A decalcified valve, taken from one specimen in very good condition from Shikok (Japan) showed that the aesthetes are lengthened by ramifying in oval cavities, the extremities of which are turned towards the umbo and allow the macroaesthetes to become level, and from whose circumference the microaesthetes come off, very small, on long peduncles and surrounding the macroaesthetes; the microaesthetes, which are very slender and very easily displaced, generally appear to number about six per aesthete. The aesthetes are rather regularly placed in the median areas, where they are level in transverse rows and often in groups of two or three. On the lateral areas, their disposition is less regular, more or less in quincunx, and cut across by large zones of growth. In the lateral areas and the pleural areas, the extrapigmentary ocelli are level among the aesthetes.

ACKNOWLEDGMENTS:

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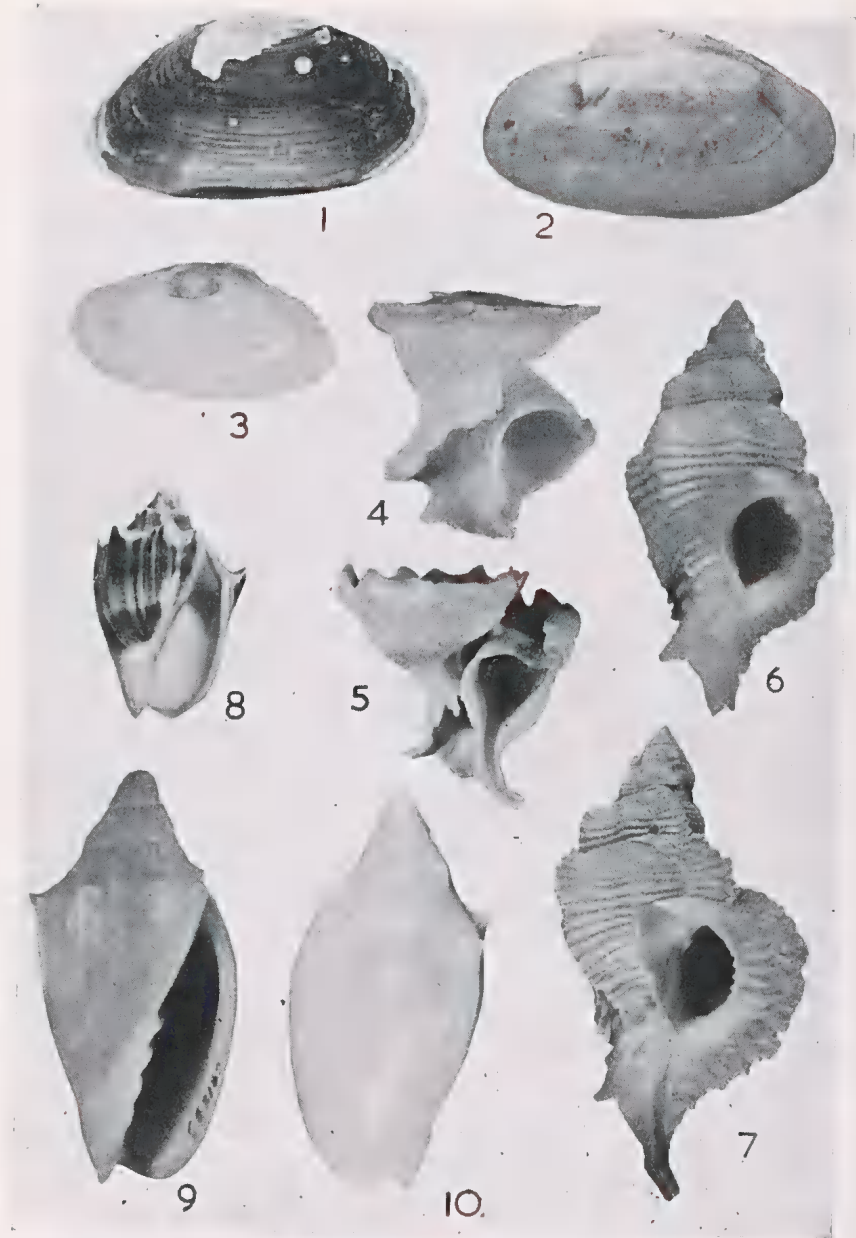


PLATE 4.

Figs. 1, 2: *Psammotaca crassula* (Deshayes). Clarence River, N.S.W. Aust. Mus., C. 63355. Mag. X1

Fig. 3: *Psammotaca crassula* (Deshayes). Aboriginal campsite, Clarence River, N.S.W. Aust. Mus., C 63356. Mag. X1